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ABSTRACT:

A picture decoding synchronizing circuit and a picture decoding synchronizing method are provided. When the decoding synchronization is controlled in units of a picture, in a variable length decoder (120) using the transferred PTS and DTS information, the value obtained by adding the previous DTS to an offset is determined to be the DTS value of the current picture, if errors are generated in the transferred PTS and DTS, considering the errors of the transferred bit stream. If no errors are generated in the PTS or DTS, then the transferred PTS and DTS are determined to be the DTS value of the current picture. By controlling the picture decoding using the determined DTS value, the bit buffer does not underflow or overflow and the decoded data is displayed naturally on a screen.

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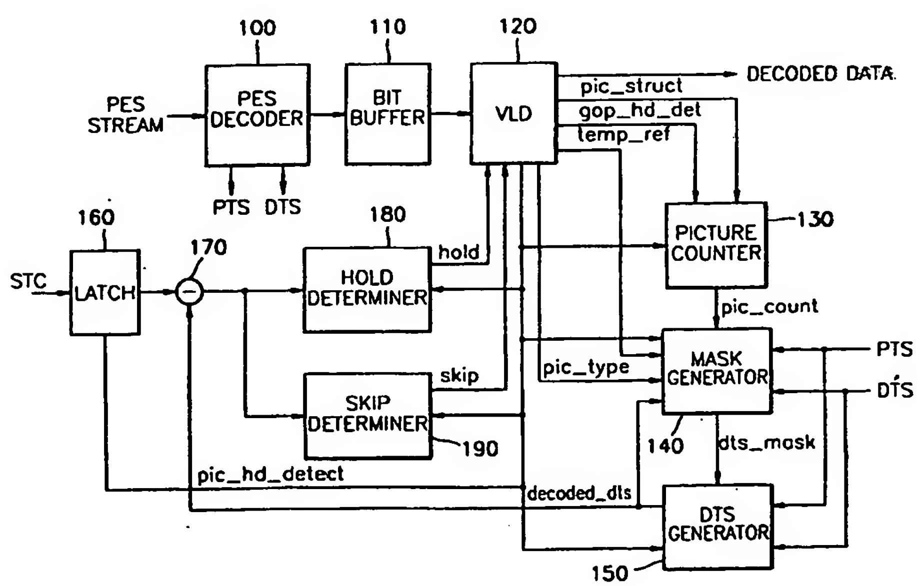
(54) **Synchronizing circuit and method for a video data decoder**

(57) A picture decoding synchronizing circuit and a picture decoding synchronizing method are provided. When the decoding synchronization is controlled in units of a picture, in a variable length decoder (120) using the transferred PTS and DTS information, the value obtained by adding the previous DTS to an offset is determined to be the DTS value of the current picture, if errors are generated in the transferred PTS and DTS, considering the errors of the transferred bit stream. If no errors are generated in the PTS or DTS, then the transferred PTS and DTS are determined to be the DTS value of the current picture. By controlling the picture decoding using the determined DTS value, the bit buffer does not underflow or overflow and the decoded data is displayed naturally on a screen.

FIG. 2



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Description

[0001] The present invention relates to a video decoder, and more particularly, to a circuit for synchronizing a picture for controlling a decoding synchronism in units of a picture so as not to underflow or overflow a bit buffer for a variable length decoder (VLD), and a method therefor.

[0002] In the MPEG-2 (moving picture experts group) system, a picture may be an I (intra-coded) picture, a B (bidirectionally predictive-coded) picture, and a P (predictive-coded) picture. The MPEG-2 video is coded in units of a frame or units of a field. The I picture can be decoded regardless of other pictures. The P picture can be decoded from preceding I or P pictures. The B picture can be decoded from preceding I or P pictures and successive I or P pictures. When the input includes all of I, B, and P pictures, it is possible to restore an original picture only by appropriately controlling decoding timing and output timing so the decoding order is different from the output (display) order.

[0003] Figure 1 is a block diagram of a video decoder for describing a conventional picture decoding synchronizing method. In Figure 1, a packetized elementary stream (PES) decoder 10 parses an input PES stream, outputs a video elementary stream to a bit buffer 20, and outputs a presentation time stamp (PTS) and a decoding time stamp (DTS) to a variable length decoder (VLD) 30. The VLD 30 receives the video elementary stream output from the bit buffer 20 in units of a picture (frame) and determines the point of time at which the picture is to be decoded according to the parsed PTS and DTS. When both the PTS and the DTS exist, the DTS is determined to indicate the point in time at which the picture is decoded. When only the PTS exists, the PTS is determined to indicate the point in time at which the picture is decoded.

[0004] When the decoding point of time of the picture unit is determined by the VLD 30 using only the PTS and the DTS output from the PES decoder 10, problems occur if the PES stream is damaged by undesirable states such as an error in a transmission channel with respect to the transferred bit stream. If the damaged portion is the PTS or the DTS, the decoding order and the output order do not coincide with the original decoding order and the output order when the picture decoding is synchronized in units of a picture in the VLD 30 according to the damaged PTS and DTS.

[0005] Namely, it is determined whether a predetermined number of pictures are to be discarded without being decoded or the pictures are to be held for a predetermined time in the VLD 30 according to the deviation between the original PTS and DTS and the erroneous PTS and DTS. Accordingly, an unattractive result is obtained when the decoded output is displayed on a screen.

[0006] It is an aim of the present invention to provide a picture decoding synchronizing circuit, in which a bit buffer does not overflow or underflow because a picture is decoded using a presentation time stamp (PTS) and a decoding time stamp (DTS) if they are undamaged, and otherwise not using them, in a video decoder.

[0007] It is another aim of the present invention to provide a picture decoding method in which the PTS and the DTS are used if they are undamaged, and otherwise not used.

[0008] According to the present invention there is provided a picture decoding synchronizing circuit as set forth in claim 1 or 6 apended hereto, and a picture decoding synchronizing method as set forth in claims 12 or 17 apended hereto. Further features of the present invention will be apparent from the dependent claims and the following description.

[0009] In a first aspect of the present invention, there is provided a picture decoding synchronizing circuit, comprising a detector for detecting whether a presentation time stamp (PTS) and a decoding time stamp (DTS) which are transferred through an input bit stream are distorted by errors, and outputting a detect signal, a determiner for determining DTS value using a transferred PTS and DTS if no errors are detected from the transferred PTS and DTS according to the detect signal, and determining the DTS value using the value obtained by adding the DTS value of a previous picture to a predetermined offset value, if errors are detected, and a decoder for decoding the input bit stream in units of a picture, in synchronization with a determined DTS value.

[0010] In a second aspect of the present invention, there is provided a picture decoding synchronizing method, comprising the steps of (a) determining whether a presentation time stamp (PTS) and a decoding time stamp (DTS), transferred through an input bit stream, are distorted, (b) determining DTS value using a transferred PTS and the DTS if no errors are detected in the transferred PTS and DTS, according to a detect signal, and otherwise, determining the DTS value by adding the DTS value of a previous picture to an offset value, and (c) decoding the input bit stream in units of a picture, in synchronization with a determined DTS value.

[0011] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a block diagram of a video decoder for describing a conventional picture decoding synchronizing circuit;

Figure 2 is a block diagram of a picture decoding synchronizing circuit according to an embodiment of the present invention;

Figure 3 shows a state of the operation of the picture decoding synchronizing circuit shown in Figure 2 when the PTS and the DTS are normal; and

Figure 4 shows a state of the operation of the picture decoding synchronizing circuit shown in Figure 2 when there are errors in the PTS and the DTS.

[0012] Hereinafter, preferred embodiments of a picture decoding synchronizing circuit and a picture decoding synchronizing method according to the present invention will be described with reference to the attached drawings.

[0013] In Figure 2, when a packeted elementary stream (PES) is input to a PES decoder 100, the PES decoder 100 parses the PES stream, selects only the PES packet corresponding to a video elementary stream, removes the header of the selected PES packet, and outputs a video elementary stream. The video elementary stream is written to a bit buffer 110 and is read according to a hold signal and a skip signal, which will be described below.

[0014] A variable length decoder (VLD) 120 outputs the signals defined by an MPEG-2 syntax, which are a picture structure (pic_struct) signal showing whether a transferred picture is a frame unit or a field unit, a group of pictures (GOP) header detect(gop_hd_det) signal for indicating that a GOP is detected, a temporal reference (tem_ref) information showing the order in which the pictures existing in the GOP are displayed, a picture type (pic_type) signal showing whether the pictures input to the VLD 120 are I picture, P picture, or B picture, and a picture header detect (pic_hd_det) signal indicating that a picture header is detected.

[0015] A picture counter 130 receives the picture structure (pic_struct) signal, the GOP header detect (gop_hd_det) signal, and a picture header detect (pic_hd_det) signal and counts them in units of a picture. Namely, counting is performed in synchronization with the picture header detect (pic_hd_detect) signal. If the picture structure (pict_struct) signal is "3" (referring to a frame picture), the count value is incremented when every picture header detect (pic_hd_detect) signal is detected. If not (i.e. referring to a field picture), the count value is incremented when every two picture header detect (pic_hd_detect) signals are detected. Also, the picture counter 130 is synchronized with the picture header detect (pic_hd_detect) signal and resets the count value to "0" when the GOP header detect (gop_hd_detect) signal is input. Namely, the picture counter 130 is reset every GOP unit and counts the number of pictures in the GOP.

[0016] A DTS generator 150 generates decoded DTS (decoded_dts) values used for a decoding in the VLD 120 using the DTS and the PTS parsed by the PES decoder 100 and a DTS mask (dts_mask) signal generated by a mask generator 140, and latches it according to the picture header detect (pic_hd_detect) signal output from the VLD 120.

[0017] The mask generator 140 generates the DTS mask (dts_mask) signal using the picture type (pic_type) signal and the temporal reference (temp_ref) information output from the VLD 120, the picture count (pic_count) value counted in the picture counter 130 and the decoded DTS (decoded_dts) value generated by the DTS generator 150. The DTS mask (dts_mask) signal is for showing that errors are generated in the transferred PTS and DTS, and is active from the point in time at which the errors are generated in the transferred PTS and DTS to the point in time at which the first picture (the I picture) of the GOP in which errors are not generated in the transferred PTS and DTS. This will be described in more detail in Figure 4.

[0018] Since the decoded DTS (decoded_dts) value of the current picture is latched according to the picture header detect (pic_hd_detect) signal in the DTS generator 150, it is determined whether the DTS mask (dts_mask) signal is to be set or reset in the mask generator 140 after the picture header detect (pic_hd_detect) signal is detected and after a delay of one or two clock cycles.

[0019] The decoded DTS (decoded_dts) value generated in this way is applied to a subtracter 170. A latch 160 latches a system time clock (STC) increasing at a rate of 90KHz per second (synchronized with a program clock reference (PCR) loaded in the header of a transport packet stream). The subtracter 170 subtracts the decoded DTS (decoded_dts) value from the stc value latched in the latch 160, compares the absolute of the subtracted result with a threshold value, and outputs the compared result to a hold determiner 180 and a skip determiner 190. Here, the threshold value is a predetermined constant (900) and is a limiting value showing the range within which a hold or a skip is allowed.

[0020] The hold determiner 180 generates a hold signal for commanding not to continue a decoding and to hold, on the basis of the compared result, and outputs the hold signal to the VLD 120. The skip determiner 190 generates a skip signal for commanding not to decode the current picture and discard it, on the basis of the compared result, and outputs the skip signal to the VLD 120.

[0021] The point in time at which the hold determiner 180 and the skip determiner 190 must determine whether the current picture is to be held or skipped is the point in time at which a plurality of clocks are delayed after the picture header detect (pic_hd_detect) signal is detected. At this point in time, the hold signal or the skip signal is generated.

[0022] A method for determining whether the PTS and the DTS parsed in the PES decoder 100 are distorted by errors, and a method for decoding a picture in synchronization with the DTS value determined in units of a picture, without generating overflow or underflow in the bit buffer 110 in the VLD 120 using the DTS of a picture unit determined

according to whether the PTS and DTS have errors, will be described with reference to Figures 3 and 4. In the described method, when the PTS and the DTS are found to be distorted by the errors, they will not be used.

[0023] First, there is the following relationship between the PTS and the DTS, transferred as part of the header of the PES. The DTS is detected in the PES header and shows when the picture corresponding thereto is to be decoded on the video elementary stream which is the output of the PES decoder 100. The PTS is detected from the PES header and shows when the picture corresponding thereto is to be displayed on a screen. The PTS is necessary since the displaying order is different from the decoding order, according to the kind of picture.

[0024] The relationship between the DTS and the PTS is determined by the following rule. The relationship between the DTS and the PTS of the I and P pictures is variable according to the number of B pictures. The DTS and the PTS are identical in the B picture. The DTS increases with a certain offset in every picture. The offset value is related to the frame rate of the decoded elementary bit stream. For example, when the frame rate is 30, the offset is 90,000/30, i.e., 3,000. Here, 90,000 denotes the 90KHz clock used in a video encoder, which is not shown. When the DTS is determined, the PTS is determined by the following equation 1.

$$\text{[Equation 1]} \qquad PTS = N + (temporalreference + 1)xoffset$$

[0025] Wherein the offset is 3,000 and N represents the DTS value of the first picture. The temporal reference represents the order in which the pictures existing in the GOP are displayed.

[0026] For example, when nine pictures exist in an arbitrary GOP and two B pictures exist between the reference pictures (I or P pictures) as shown in Figure 3(a), the temporal reference information is 2 0 1 5 3 4 8 6 7. Here, Figure 3 (a) shows the occupancy of data according to the order in which pictures are input to the bit buffer 110. In "I2", I and 2 respectively denote an I picture and the temporal reference information.

[0027] Figures 3(b) and 3(c) respectively show the DTS and the PTS determined in the video encoder with respect to arbitrary pictures. For example, when the DTS of the I picture (which is the first picture of the GOP) is N, the DTS of the P5 picture becomes N+3×M and the PTS becomes N+6×M.

[0028] In Figures 3(d) through 3(h) the picture is ideally decoded by the VLD 120 in synchronization with the DTS when there is no error in the transferred bit stream, namely, there are no errors in the PTS and the DTS.

[0029] In the video encoder, the PTS and the DTS are all transferred in the video encoder only when the values thereof are different from each other in an arbitrary picture. Only the PTS is transferred when the values are equal. Therefore, the DTS is not transferred with respect to the B picture. However, the DTS cannot be transferred without the PTS. The PTS and the DTS do not have to be transferred in every picture. According to the MPEG-2 specification, they only have to be transferred at least once every 0.7sec.

[0030] The picture header detect (pic_hd_det) signal shown in Figure 3(d) is generated when the decoding of the picture headers is completed in the VLD 120. The PTS and the DTS parsed by the PES decoder 100 shown in Figures 3(e) and 3(f) are latched according to the picture header detect (pic_hd_det) signal in the DTS generator 150.

[0031] An elementary picture decoding method in a normal state in which there are no errors in the PTS and the DTS is as follows. When the PTS and the DTS of an arbitrary picture are both transferred, the DTS generator 150 determines the DTS to be the DTS of the picture. When only the PTS is transferred, the DTS generator 150 determines the PTS to be the DTS and generates the decoded DTS (decoded_dts) value. With respect to the picture not having the PTS and the DTS, the DTS generator 150 determines the value obtained by adding the DTS of the previous picture to the offset as the DTS of the present picture and outputs the decoded DTS (decoded_dts) value. As a result, the finally determined DTS is the same as the DTS determined in the video encoder shown in Figure 3(b).

[0032] Also, the latch 160 latches the STC increasing at the rate of 90KHz per second in synchronization with the program code reference (PCR) included in the header of a transport stream (TS) by the picture header detect (pic_hd_det) signal. The subtracter 170 subtracts the decoded DTS value from the latched STC value. When the value is negative, the decoding in the VLD 120 is delayed. When the value is positive, the current picture is not decoded and is discarded.

[0033] The subtracter 170 determines whether the result obtained by subtracting the decoded DTS value from the STC value is larger than a threshold value (900). For this, the absolute value of the subtraction result is obtained, the absolute value is subtracted from the threshold value, and it is determined whether the result is negative or positive. When the value is positive, since the absolute value is smaller than the threshold value, no hold or skip is generated. When the value is negative, a hold or skip may be generated. After subtracting the absolute value from the threshold value, it is determined whether the skip signal for skipping the current picture or the hold signal for delaying the current picture is to be generated at the point in time (Figure 3(g)) at which the picture header detect (pic_hd_det) signal is delayed by a predetermined number of clock cycles.

[0034] When a hold signal of logic "low" is generated by the hold determiner 180 as shown in Figure 3(h) at the point in time (Figure 3(g)) a predetermined number of clock cycles after the picture header detect (pic_hd_det) signal, on

the basis of the output of the subtracter 170, the decoding of the input picture is delayed in the VLD 120. When the skip signal is generated by the skip generator 190 after a delay of a determined number of clock cycles from the picture header detect (pic_hd_det) signal, on the basis of the output of the subtracter 170, the VLD 120 does not decode and discards the current pictures input when the skip signal is generated. In Figure 3, the hold is generated for every picture.

[0035] When the VLD 120 completes the decoding of a picture within an offset period, the value obtained by subtracting the decoded DTS value from the STC value is negative. When the absolute value of the subtraction result is outside the range of the threshold value, the VLD 120 generates the hold signal and controls the decoding period of a picture to 1/picture rate. On the other hand, when the VLD 120 does not complete the decoding of a picture within an offset period, the value obtained by subtracting the decoded DTS value from the STC value is positive. When the absolute value of the subtraction result is outside the range of the threshold value, the VLD 120 generates the skip signal, and does not decode the picture but instead discards it.

[0036] So far, a method has been described of synchronizing the decoding of the picture unit in the VLD using the PTS and the DTS in a normal state. From now on, a picture decoding synchronizing method using the PTS and the DTS considering the errors, which is the purpose of the present embodiment of the invention, will be described.

[0037] The transferred PTS and DTS may not be detected by the PES decoder 100 due to errors. Also, the transferred PTS and DTS may be detected in the PES decoder 100, but erroneously, due to errors.

[0038] In the former case, when the picture of the elementary stream corresponding to the undetected PTS and DTS is not damaged by errors, the VLD 120 determines that there is no time stamp in the picture and decodes the picture using the value obtained by adding the DTS of the previous picture to the offset value as the DTS of the picture. When the picture is discarded by the VLD 120 due to error, the hold is generated in the picture corresponding to the PTS and the DTS according to the PTS and the DTS found in the successive picture, so only as many pictures are undetected by the VLD 120 are not decoded.

[0039] However, in the latter case, the problem is serious if the transferred PTS and DTS are much larger than the original value. Since the PTS and the DTS have the value of 33 bits, though the PTS and DTS is one bit which is close to the most significant bit (MSB), if the PTS and DTS which is "0" is wrongly detected as "1", there exists a very big difference between the threshold value and the value obtained by subtracting the decoded DTS value from the STC value in the subtracter 170. The decoding can be held for a long time. When the transferred PTS and DTS are smaller than the original value, though the value obtained by subtracting the decoded DTS value from the STC value is very large, the pictures are skipped until the PTS and the DTS are found. Accordingly, the PTS and DTS are not seriously affected.

[0040] In the present invention, the temporal reference information (tem_ref), the picture counter 130, the mask generator 140, and the DTS generator 150 are used as shown in Figure 2 against the case in which the transferred PTS and DTS are much larger than the original value, as in the latter case. The picture counter 130 performs counting in synchronization with the picture header detect (pic_hd_det) signal output from the VLD 120. The picture counter 130 is reset to "0" at the first picture in the GOP and increases by "1" at other pictures.

[0041] The relationship established among the PTS, the DTS, the temporal reference information, and the output of the picture counter in a GOP is shown in the following equations 2 and 3.

[Equation 2] *PTS=transferred DTS + (temporal reference-picture count value + 1)xoffset*

[Equation 3] *transferred DTS=previous DTS=offset*

[0042] When the picture input to the VLD 120 is an I or P picture, the condition of equation 2 is not satisfied. When the picture input to the VLD 120 is a B picture, the condition of equation 3 is not satisfied. Namely, when the current input picture does not satisfy the condition of equations 2 or 3, the PTS and the DTS transferred from the current input picture to the final picture of the GOP are not used. Also, when the first picture of the successive GOP is an I picture, the PTS and the DTS exist, and the above conditions are not satisfied, the PTS and the DTS continuously transferred to the GOP are not used. Namely, the PTS and the DTS transferred to all the pictures are discarded until the first picture of the GOP satisfying the conditions is found.

[0043] According to the MPEG specification, the first picture of the GOP is an I picture. In an I picture, if a time stamp exists, then the PTS and the DTS must also exist. In Figure 4, such a relationship is described, employing arbitrary numbers. The transferred PTS and DTS are not detected in the PES decoder 100 due to the errors. The bits of the pictures corresponding to the PTS and the DTS are discarded in the VLD 120 due to the errors.

[0044] Namely, as shown in Figure 4(a), the PTS and the DTS of the pictures corresponding to P5 are not transferred and the bits are damaged and discarded in the VLD 120. The PTS of the following B3 picture is detected and the picture header corresponding to the picture is detected. The picture header detect (pic_hd_det) signal is generated as shown

in Figure 4(b).

[0045] Since the transferred PTS is 45,000 as shown in Figure 4(c) and the picture is a B picture, the DTS generator 150 interprets the PTS as the DTS value. Figure 4(d) shows the transferred DTS. Figure 4(e) shows the value obtained by counting the pictures in the picture counter 130 according to the picture structure (pic_struct) signal and the picture header detect (pic_he_det) signal output from the VLD 120.

[0046] Since the DTS value decoded by the DTS generator 150 with respect to the B3 picture does not satisfy the condition of equation 3, the mask generator 140 generates the DTS mask signal (dts_mask) shown in Figure 4(f) as an active signal of logic "low". The DTS mask (dts_mask) signal is maintained in the logic "low" state until the first I picture of the successive GOP satisfies all the conditions of equations 2 and 3. When the DTS mask (dts_mask) signal is in the logic "low" state, the value obtained by adding the DTS of the previous picture to the offset is used as the decoded DTS value whenever the picture header detect signal is found, without employing the transferred PTS or DTS. Therefore, the DTS generator 150 outputs the decoded DTS (decoded_dts) value as shown in Figure 4(g).

[0047] In the following GOP, when the PTS and the DTS of the first I picture satisfy the conditions of equations 2 and 3, the DTS mask (dts_mask) signal is logic "high" in the first I picture of the GOP. The transferred DTS of the first I picture is decoded as the DTS of the I picture. The VLD 120 performs decoding, holding, or skipping in units of a picture, according to the value obtained by subtracting the decoded DTS value from the STC value and the threshold value when the DTS mask (dts_mask) signal is logic "low". When the DTS mask (dts_mask) signal shown in Figure 4(f) is logic "high", the I picture is held as much as the absolute value of the value (-3,900 in Figure 4(i)) obtained by subtracting the decoded DTS value (60,000 in Figure 4 (g)) from the STC value (56,100 in Figure 4(h)). This is because the value obtained by subtracting the decoded DTS value from the STC value becomes larger than the number of pictures discarded due to the errors in the VLD 120 (1(P5) in Figure 4) x the offset (-3,900 in Figure 4(i)).

[0048] Figure 4(h) shows the STC value latched by the latch 160 according to the picture header detect (pic_hd_det) signal. Figure 4(i) shows the value obtained by subtracting the DTS value decoded by the DTS generator 150 from the STC value latched in the latch 160. Figure 4(j) shows the threshold value (900).

[0049] Since the VLD 120 completes decoding all the pictures in a GOP within 3,000, which is the offset value, the value obtained by subtracting the decoded DTS value from the STC is negative as shown in Figure 4(i). If the absolute value of the subtraction result is outside the range of the threshold value at the determining point in time shown in Figure 4(k), the skip or hold is generated. If not, the decoding is continuously performed. In Figure 4(i), the VLD 120 temporarily stops when the hold signal of logic "low" is generated by the hold determiner 180.

[0050] In the method and apparatus described above, even when there are errors in the transferred DTS and PTS, the decoded image data displayed naturally on a screen.

[0051] The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0052] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0053] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0054] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A picture decoding synchronizing circuit, comprising:

   a detector (130,140) for detecting whether a presentation time stamp and a decoding time stamp which are transferred through an input bit stream are distorted by errors, and outputting a detect signal;

   a determiner (150) for determining DTS value using a transferred PTS and DTS if no errors are detected from the transferred PTS and DTS according to the detect signal, and determining the DTS value using the value obtained by adding the DTS value of a previous picture to a predetermined offset value, if errors are detected; and

a decoder (120) for decoding the input bit stream in units of a picture, in synchronization with a determined DTS value.

2. The picture decoding synchronizing circuit of claim 1, wherein the detector comprises:

a picture counter (130) for counting the number of pictures in a group of picture unit and outputting a picture count value; and

a generator (140) for detecting errors generated in the transferred DTS and PTS using a picture type signal showing whether an input picture is an I intra-coded, B bidirectionally predictive-coded, or P predictive-coded picture, temporal reference information showing the display order of the pictures in the GOP, and the picture count value, and generating a detect signal.

3. The picture decoding synchronizing circuit of claim 2, wherein the detector (130,140) detects whether the PTS of input I and P pictures satisfies the following condition and, if not, generates a detect signal:

$$PTS = transferred\ DTS + (temporal\ reference\ information - picture\ count\ value + 1) \times offset$$

4. The picture decoding synchronizing circuit of claim 2 or 3, wherein the detector (130,140) detects whether the DTS of the input B picture satisfies the following condition and, if not, generates a detect signal:

$$transferred\ DTS = previous\ DTS + offset$$

5. The picture decoding synchronizing circuit of any of claims 1 to 4, wherein the detector (130,140) generates a detect signal which is active from the current picture to the first picture of the GOP in which no errors are detected in the transferred PTS and DTS, when errors are detected in the PTS and DTS of the current picture.

6. A picture decoding synchronizing circuit, comprising:

an extractor (100) for extracting a video elementary stream, a presentation time stamp PTS, a decoding time stamp DTS, and a system time clock STC from a transferred bit stream;

a buffer (110) for temporarily storing the video elementary stream;

a variable length decoder (120) for controlling the decoding of the video elementary stream stored in the buffer so that the buffer does not overflow or underflow, parsing the header of the video elementary stream, and outputting temporal reference information, a picture structure signal, a GOP header detect signal, and a picture type signal; and

a decoding controller (130,140) for determining whether errors are generated in the DTS and the PTS and generating control signals for controlling the decoding using a determined DTS value by adding the DTS of the previous picture to an offset value, if the errors are generated.

7. The picture decoding synchronizing circuit of claim 6, wherein the decoding controller comprises:

a picture counter (130) which is reset according to the GOP header detect signal, for counting the number of pictures according to the picture structure signal and the picture header detect signal, and outputting a picture counted value;

a first generator (140) for determining whether there are errors in the DTS and the PTS using the picture type signal, temporal reference information, and the picture counted value and generating a mask signal;

a second generator (150) for generating a decoded DTS value by adding the DTS value of the previous picture to the offset value, if the mask signal is generated and otherwise, generating the decoded DTS value on the basis of the transferred PTS and DTS;

a subtracter (170) for subtracting the decoded DTS value from the STC value, comparing the absolute value of the subtraction result with a threshold value, and outputting a comparison result;

a hold determiner (180) for generating a hold signal commanding the decoding not to proceed according to the comparison result and to hold, and outputting the hold signal to the variable length decoder; and

a skip determiner (190) for generating a skip signal commanding the current picture to be discarded without being decoded, according to the comparison result, and outputting the skip signal to the variable length decoder.

8. The picture decoding synchronizing circuit of claim 7, wherein the first generator (140) generates the mask signal when the PTS of the input I and P pictures does not satisfy the following condition:

$$PTS = transferred\ DTS + (temporal\ reference\ information - picture\ count\ value + 1) \times offset$$

9. The picture decoding synchronizing circuit of claim 7 or 8, wherein the first generator (140) generates the mask signal when the DTS of the input B picture does not satisfy the following condition:

$$transferred\ DTS = previous\ DTS + offset$$

10. The picture decoding synchronizing circuit of any of claims 7 to 9, wherein the first generator (140) generates a mask signal which is active from the current picture to the first picture of the GOP in which no errors are generated in the transferred PTS and DTS, when errors are generated in the PTS and the DTS of the current picture.

11. The picture decoding synchronizing circuit of any of claims 7 to 10, wherein the point in time at which it is determined whether the hold signal or the skip signal is to be generated in the hold determiner (180) and the skip determiner (190) is a predetermined number of system clock cycles after the picture header detect signal.

12. A picture decoding synchronizing method, comprising the steps of:

(a) determining (130,140) whether a presentation time stamp PTS and a decoding time stamp DTS, transferred through an input bit stream, are distorted;

(b) determining (150) DTS value using a transferred PTS and the DTS if no errors are detected in the transferred PTS and DTS, according to a detect signal, and otherwise, determining the DTS value by adding the DTS value of a previous picture to an offset value; and

(c) decoding (120) the input bit stream in units of a picture, in synchronization with a determined DTS value.

13. The picture decoding synchronizing method of claim 12, wherein the step (a) comprises the steps of:

(a1) counting (130) the number of pictures in a group of picture (GOP) unit and outputting a picture count value; and

(a2) detecting (140) errors generated in the transferred DTS and PTS using a picture type signal showing whether an input picture is an I (intra-coded), B (bidirectionally predictive-coded), or P (predictive-coded) picture, temporal reference information showing the display order of the pictures in the GOP, and the picture count value and generating a detect signal.

14. The picture decoding synchronizing method of claim 13, wherein it is detected whether the PTS of the input I and P pictures satisfies the following condition, and the detect signal is generated in the step (a2):

$$PTS = transferred\ DTS + (temporal\ reference\ information - picture\ count\ value + 1) \times offset$$

15. The picture decoding synchronizing method of claim 13 or 14, wherein it is detected whether the DTS of the input

B pictures satisfies the following condition, and the detect signal is generated in the step (a2):

transferred DTS=previous DTS+offset

16. The picture decoding synchronizing method of any of claims 12 to 14, wherein a detect signal is generated which is active from the current picture to the first picture of the GOP in which no errors are generated in the transferred PTS and DTS, when errors are generated in the PTS and the DTS of the current picture in the step (a).

17. A picture decoding synchronizing method, comprising the steps of:

(a) extracting (100) a video elementary stream, a presentation time stamp (PTS), a decoding time stamp (DTS), and a system time clock (STC);

(b) controlling (120) the decoding of the video elementary stream, parsing the header of the video elementary stream, and detecting temporal reference information, a picture structure signal, a GOP header detect signal, and a picture type signal; and

(c) determining (130,140) whether errors are generated in the DTS and the PTS, and when errors are generated, generating control signals for controlling the decoding using a DTS value determined by adding the DTS of a previous picture to an offset value.

18. The picture decoding synchronizing method of claim 17, wherein the step (c) comprises the steps of:

(c1) counting (130) the number of pictures in the GOP according to the picture structure signal, the picture header detect signal, and the GOP header detect signal and outputting a picture count value;

(c2) determining (140) whether errors are generated in the DTS and the PTS using the picture type signal, the temporal reference information, and the picture count value, and generating a mask signal;

(c3) generating (150) a decoded DTS value by adding the DTS value of the previous picture to the offset value if the mask signal is generated, and otherwise, generating the decoded DTS value on the basis of the transferred PTS and DTS;

(c4) subtracting (170) the decoded DTS value from the STC value, comparing the absolute value of the subtraction result with a threshold value and outputting a comparison result;

(c5) generating (180) a hold signal commanding the decoding not to proceed and to hold according to the comparison result; and

(c6) generating (190) a skip signal commanding the current picture to be discarded without being decoded, according to the comparison result.

19. The picture decoding synchronizing method of claim 18, wherein when the PTS of input I and P pictures does not satisfy the following condition, the mask signal is generated in the step (c2):

PTS=transferred DTS + (temporal reference information-picture count value + 1)xoffset

20. The picture decoding synchronizing method of claim 18 or 19, wherein when the DTS of an input B picture does not satisfy the following condition, the mask signal is generated in the step (c2):

transferred DTS=previous DTS+offset

21. The picture synchronizing method of any of claims 17 to 20, wherein the mask signal is not generated from the current picture to the first picture of the GOP in which no errors are generated in the transferred PTS and DTS when errors are generated in the PTS and the DTS of the current picture, in the step (c2).

FIG. 1

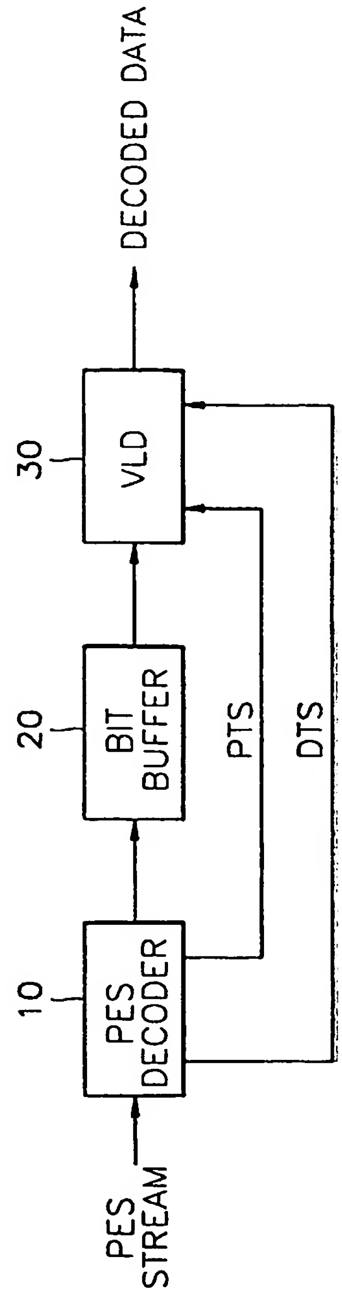

PES STREAM
10
PES DECODER
20
BIT BUFFER
30
VLD
DECODED DATA
PTS
DTS

FIG. 2

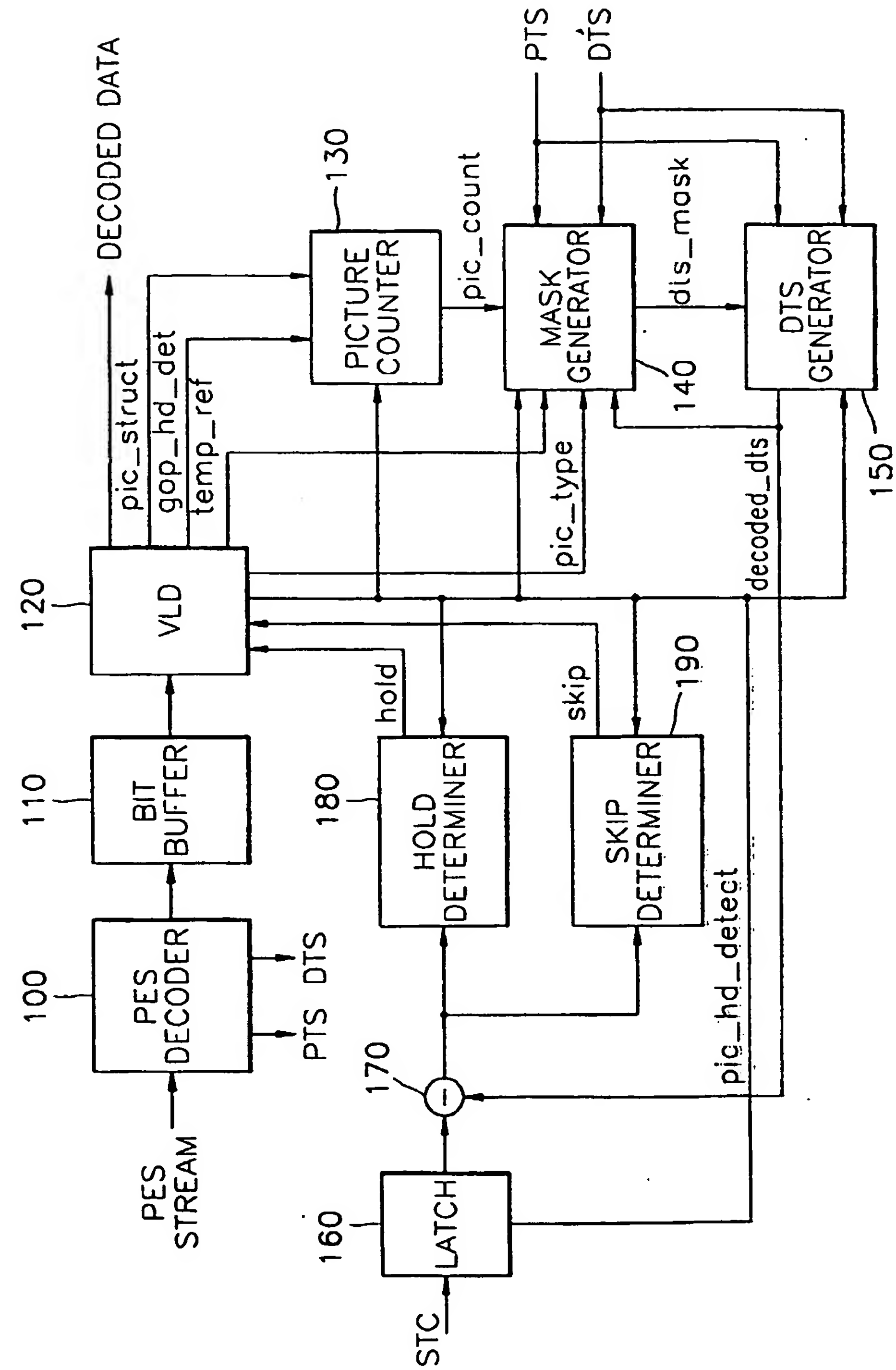
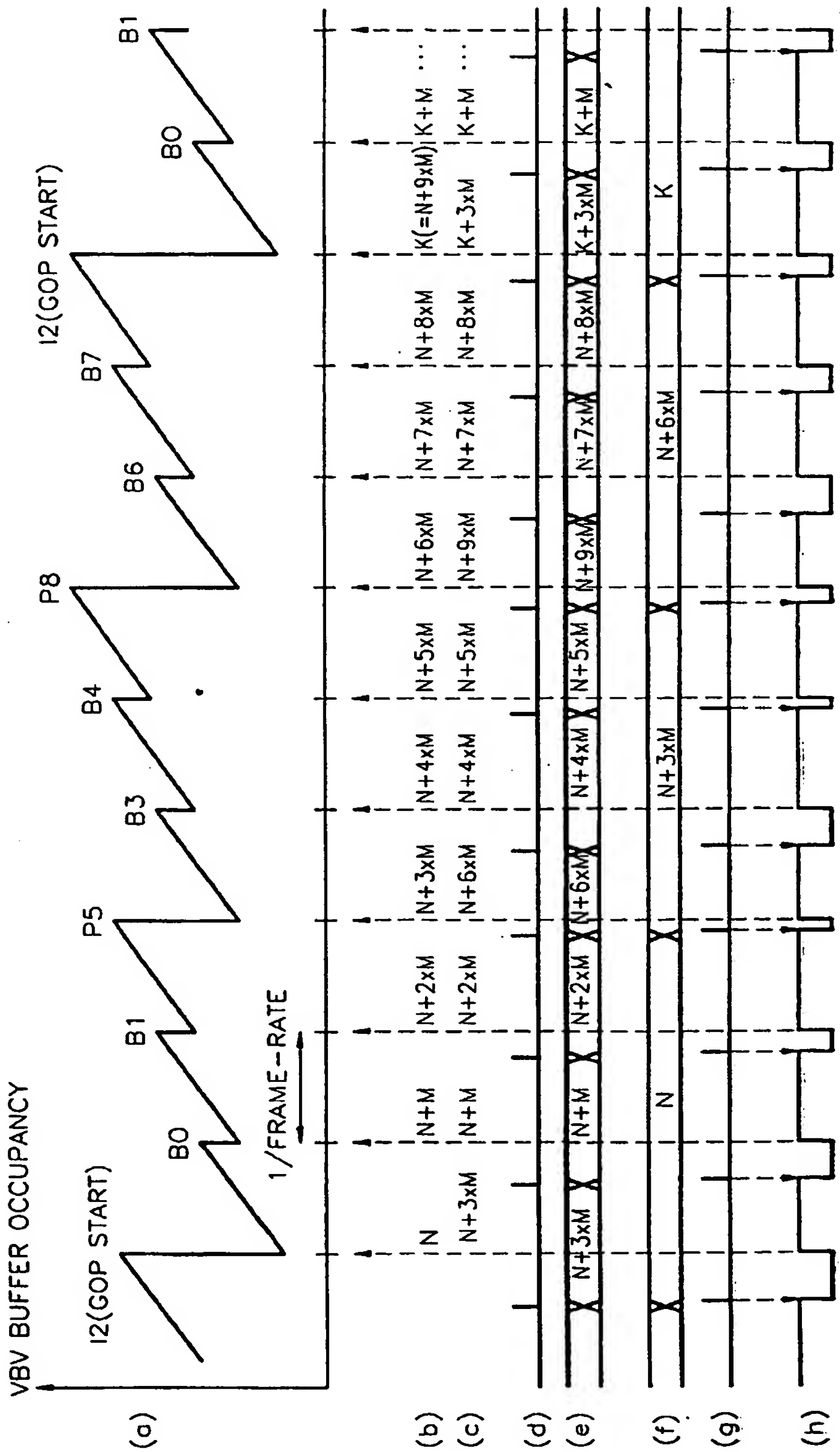
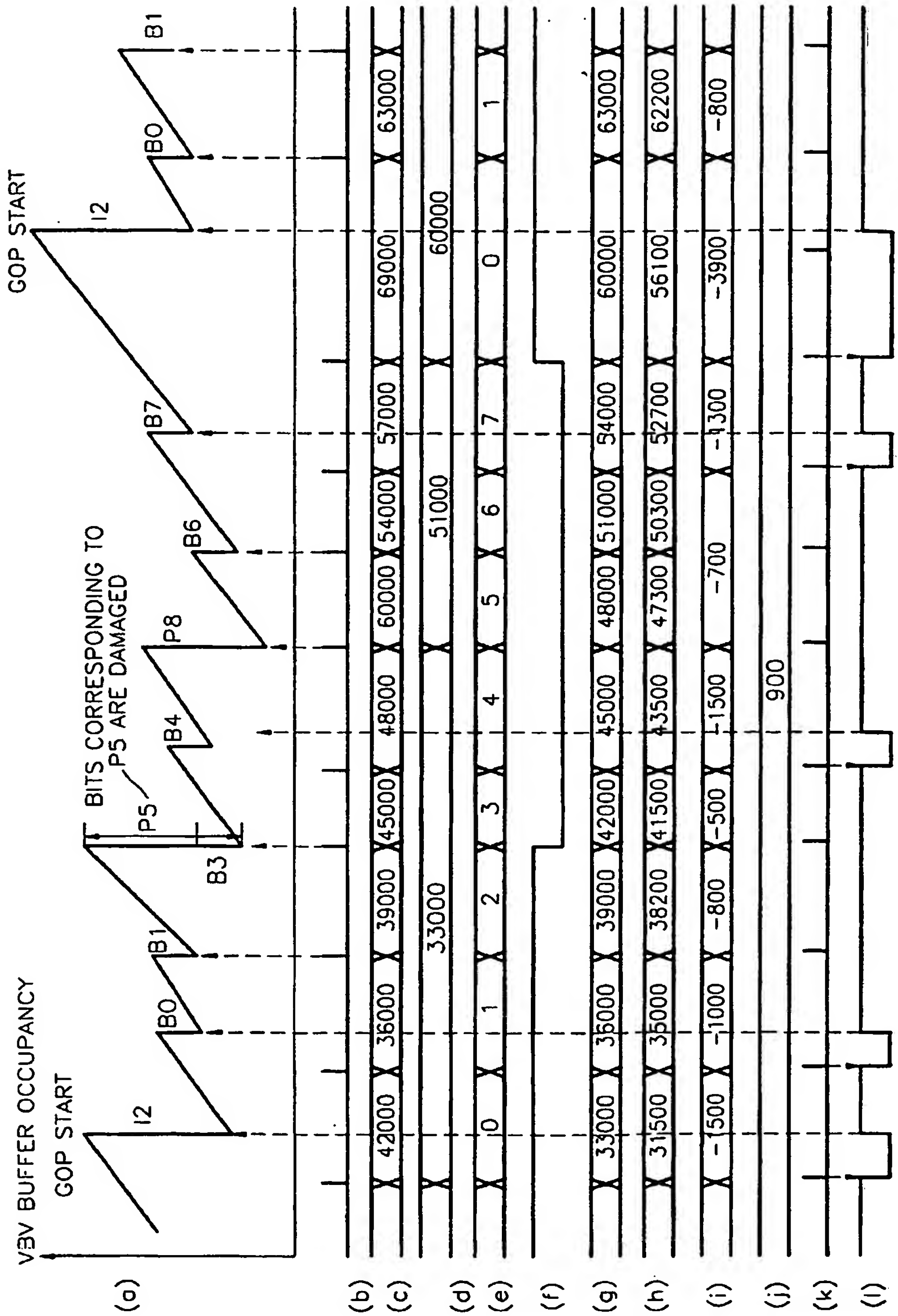

PES STREAM
100
PES DECODER
PTS
DTS
110
BIT BUFFER
120
VLD
DECODED DATA
pic_struct
gop_hd_det
temp_ref
130
PICTURE COUNTER
pic_count
140
MASK GENERATOR
PTS
DTS
dis_mask
150
DTS GENERATOR
pic_type
decoded_dts
hold
skip
180
HOLD DETERMINER
190
SKIP DETERMINER
pic_hd_detect
170
160
LATCH
STC

FIG. 3



VBV BUFFER OCCUPANCY
I2(GOP START)
B0
B1
P5
B3
B4
P8
B6
B7
I2(GOP START)
B0
B1
1/FRAME-RATE
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
N
N+M
N+2xM
N+3xM
N+4xM
N+5xM
N+6xM
N+7xM
N+8xM
K(=N+9xM)
K+M
N+3xM
N+M
N+2xM
N+6xM
N+4xM
N+5xM
N+9xM
N+7xM
N+8xM
K+3xM
K+M
N+3xM
N+M
N+2xM
N+6xM
N+4xM
N+5xM
N+9xM
N+7xM
N+8xM
K+3xM
K+M
N
N+3xM
N+6xM
K

FIG. 4


VBV BUFFER OCCUPANCY
GOP START
I2
B0
B1
P5
B3
BITS CORRESPONDING TO P5 ARE DAMAGED
B4
P8
B6
B7
GOP START
I2
B0
B1
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
(j)
(k)
(l)
42000
36000
39000
45000
48000
60000
54000
57000
69000
63000
33000
51000
60000
0
1
2
3
4
5
6
7
0
1
33000
36000
39000
42000
45000
48000
51000
54000
60000
63000
31500
35000
38200
41500
43500
47300
50300
52700
56100
62200
-1500
-1000
-800
-500
-1500
-700
-1300
-3900
-800
900